Sanitary Wastewater Treatment Plant Green Zia: Mitigation of Biostarvation

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The Challenge

The Sanitary Wastewater Treatment (SWS) Plant processes sewage from Los Alamos National Laboratory (the Laboratory) year round, approximately 250,000-350,000 gallons/day Monday through Friday. The SWS Facility was originally created to handle twice as much influent as it currently handles. Currently, the SWS Facility handles more wastewater, such as from cooling towers, than they do domestic wastewater. These two key items have led to the constant challenge of mitigating biostarvation of the SWS Facility's microbial population, which is necessary to process sewage.

This paper will discuss how the Laboratory team used the following tools to address the issues involved with mitigation of biostarvation:

- Determining opportunities in the current process using process maps;
- Rank ordering of the opportunities to improve the process using a Pareto analysis;
- Determining the root cause of the selected opportunity using a cause and effect (fishbone) diagram;
- Posing a consensus problem statement for generating process alternatives;
- Generating process alternatives;
- Selecting alternatives using a forced pairs comparison; and
- Implementing the selected alternatives with a formal action plan.

Biostarvation Mitigation Team

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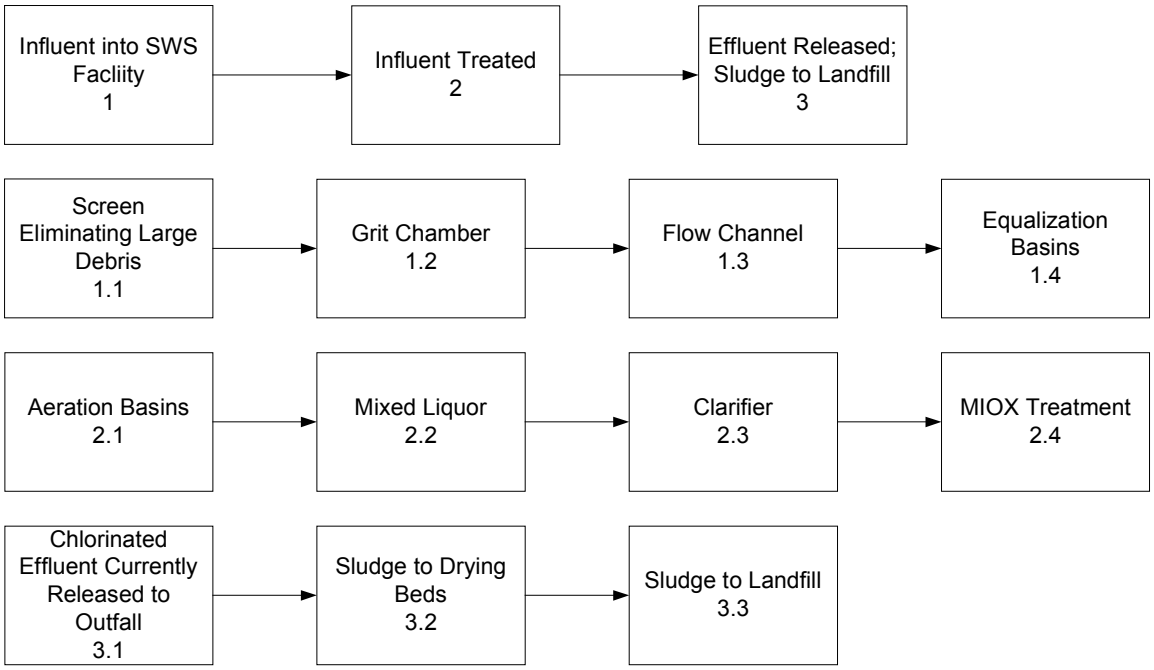
Process Mapping

The team prepared the following process map for the basic operations of the SWS Facility (see Figure 1).

Figure 1



As sewage and wastewater (influent) enters the SWS Facility, large debris and heavy sediments are removed via screens and the grit chamber. The influent then enters the equalization basins, where it collects. The influent is released from the equalization basins in increments to the aeration basins in order to maintain a steady flow. In the aeration basins, microorganisms come into contact with the influent and begin their digestion of biodegradable materials. These basins are aerated to provide oxygen for metabolization and to keep the microorganisms moving. This also allows the first steps in the nitrification process. The mixed liquor, which is the combination of microorganisms and biodegradable materials, is then moved to the clarifiers. Once in the clarifiers, it is separated into liquid and solids. Two things happen to the solids once they have settled out. In order to maintain the balanced amount of microorganism, some solids, the return activated sludge, are returned to the aeration basins. The rest of the solids, waste activated sludge, goes to the drying beds and eventually to disposal. The liquid is chlorine treated through the MIOX units, pumped up to TA-3, where it is currently released to the outfall, #001.

Rank Ordering of Opportunities

Several opportunities for improvement of the SWS Facility's operations were discussed and explored in this Green Zia. Table 1 illustrates the main opportunities considered and the relative risks associated with each issue.

Table 1

	Opportunity	Relative Risks
1	Biostarvation Mitigation	Compliance issues with NPDES permit. Inadequate food sources when the Laboratory is closed (weekends and holidays, cold weather months); starves microorganisms.
2	Grease Mitigation	Grease coats and suffocates microorganisms
3	Chemical Use Reduction at SWS	Soda ash (pH balance) and salt (Miox units; chlorination process) additives increase TDS of treated effluent.
4	TDS Reduction	High TDS limits water reuse potential; high TDS requires additional treatment prior to discharge.
5	Reuse of Treated Water	Longer-term Laboratory improvement projects are currently limited by TDS levels.

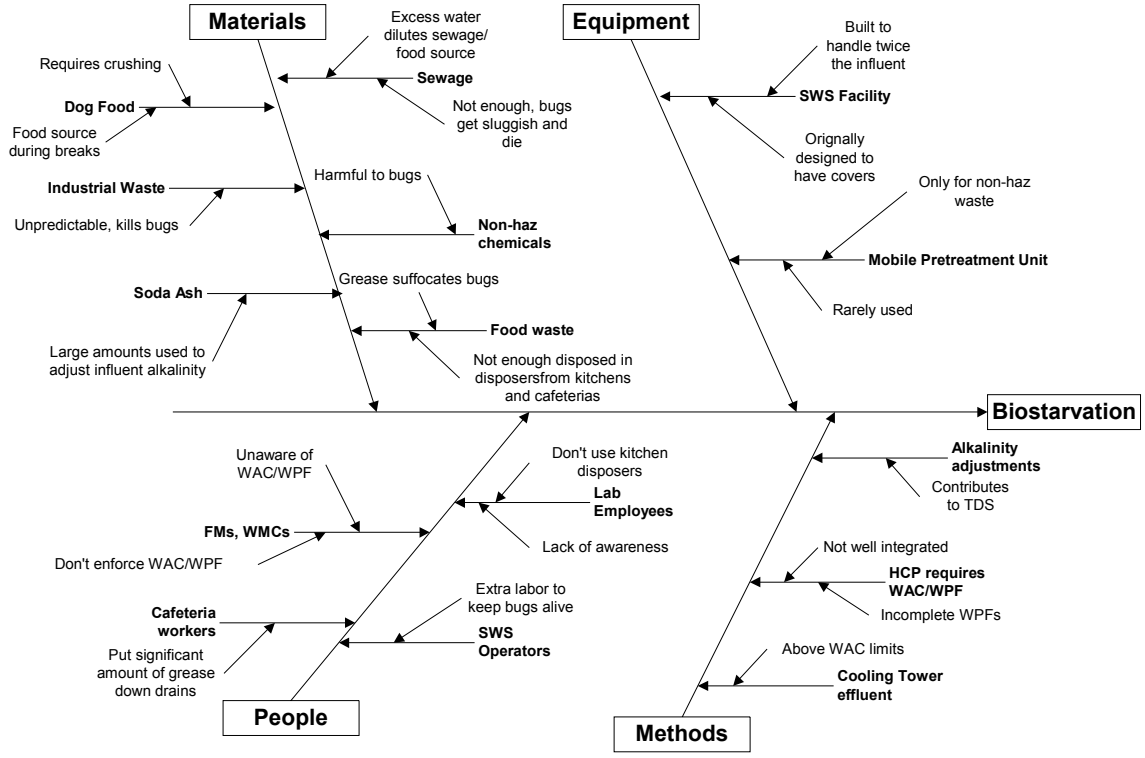
After looking at the possible opportunities, the team selected addressing the issue of biostarvation.

1. Biostarvation Mitigation: Biostarvation increases the potential for compliance problems with the Laboratory's NMED water discharge permit.
2. Grease Mitigation: Grease coats and suffocates microorganisms.
3. Chemical Use Reduction: The SWS Facility only employs two main chemicals: soda ash (sodium carbonate) for alkalinity and salt (sodium chloride) for their disinfection units (the MIOX units). These are currently being addressed by retrofits and current consumption of both chemicals will be monitored for indications of reductions.
4. TDS Reduction: With chemical use reduction will come TDS (total dissolved solids) reduction. The main contributor of TDS at the SWS Facility is the salt and soda ash.
5. Reuse of Treated Water: The team discussed possibilities for the reuse of the treated water. Currently, FWO has plans to use the reuse water at cooling towers at TA-3 once a large RO (reverse osmosis) unit is in place. It is estimated this will take approximately 100% of the reuse water. Once this is on-line, if any reuse water remains, this issue will be addressed again.

Root Cause Analysis & Statement of Problem

The team examined issues associated with operational losses with a cause and effect diagram to identify potential causes of the problem. The diagram follows, in Figure 2.

Figure 2



After reviewing the causes of operational losses, the team developed the following problem statement.

A significant amount of time and labor are spent in mitigating biostarvation. The main issues with biostarvation are:

- *The Facility was built for twice the load and originally designed with covers*
- *Unpredictable materials and amounts often enter the sewer system and create unhealthy environment for the microorganisms*
- *There is not enough domestic waste (food materials) entering the sewage system*

Generating Process Alternatives

A brain writing exercise was used by the team to generate possible alternatives to the problem. The alternatives that resulted from this activity are as follows:

- Soy Meal
- Soy Gold: addition to SWS plant directly or use as solvent/degreaser upstream and discharged to SWS
- Nitrifying organisms in pellet form for reseeding during winter break
- Enzymes: Chemzyme for grease mitigation
- Micro-Blaze used for septic tanks, holding tanks, and port-a-potties
- Micro-Blaze used upstream at heavy equipment shop, cafeterias
- Bring in trucks loads from Espanola Sewage facility during winter break
- Construct covers for aeration basins
- Purchase and install fine air bubble diffusers (energy efficient)
- Kleen Tech cleaner switch to biodegradable, helpful chemicals
- More food ground and washed down to SWS after grease issues are addressed
- FWO recharge for plant upsets
- Have WPF for each building
- Have FWO charge each FM for water usage
- Composting program: Art Torrez, Roswell
- Downsizing blower for plant-more efficient, energy savings
- Reduce cooling tower releases to SWS

Selecting an Alternative

The team used a forced pair comparison to select alternatives that should be implemented in the near future. The ease of implementation, likelihood of success, and overall impact were all considered when prioritizing alternatives. Some related alternatives were combined. The alternatives that resulted from this activity are as follows:

- Downsizing blower for plant: more efficient, energy savings
- Kleen Tech switch to biodegradable, helpful chemicals
- Micro-Blaze used for septic tanks, holding tanks, and port-a-potties
- Micro-Blaze used upstream at heavy equipment shop, cafeterias
- Enzymes: Chemzyme for grease mitigation
- Provide supplemental food year-round
- More food ground and washed down to SWS after grease issues are addressed
- Bring in trucks loads from Espanola Sewage facility during winter break
- Reduce cooling tower releases to SWS
- Have FWO charge each FM for water usage
- Construct covers for aeration basins
- Composting program: Art Torrez, Roswell
- Purchase and install fine air bubble diffusers (energy efficient)
- FWO recharge for plant upsets, requires WPF for buildings

Further discussions narrowed the field further. Three alternatives (the two involving Micro-Blaze and the one involving Chemzyme) were combined. The alternative of bringing in sewage from Espanola was taken out, since this is considered a contingency plan to be implemented if there is ever a major die-off of the SWS Facilities microorganisms. From considering the need for FWO to charge each FM for water usage, the alternative of developing a way to identify industrial discharges before they come to the SWS Facility was developed and added. The composting program alternative was removed, since it dealt with the end product of the sewage and not biostarvation mitigation. The purchase of fine air bubble diffusers was discussed further, which led to the discovery that the Facility was not designed for such bubblers and therefore it would take a total refit to do.

Action Plan

The following action plan, in Table 2, was prepared by the team to implement alternatives.

Table 2

Action Item	**Organization/POC**	**Potential Due Date**
Assess potential for providing supplemental food year-round, including activity based costing. Implement recommendations.	SWS/Environmental support services	12/02
Investigate further possibilities in downsizing of blowers at SWS plant, including activity based costing. Report recommendations to FWO for funding.	SWS/Environmental support services	12/02
Assess industrial discharges to SWS Facility and correlate chemical purchase data with monitoring data. Develop recommendations and complete an activity based costing analysis prior to submitting results to FWO and the LANL FM council for approval and funding.	RRES/Environ-mental support services	9/30/03
Investigate further possibilities of environmentally preferable cleaning materials including activity based costing. Implement recommendations.	RRES/Environ-mental support services	9/30/03
Investigate further potential uses of Micro-Blaze and Chemzyme (or similar products) in grease mitigation, including activity based costing. Implement recommendations.	Environmental support services	9/30/03
Assess potential for providing more biomass fodder by greater use of garbage disposals on-site including activity based costing. Report recommendations to RRES.	RRES/Environ-mental support services	9/30/03
Investigate potential for FWO to charge each FM for water usage including activity based costing. Report recommendations to FWO for funding.	RRES/FWO	FY04
Assess potential for constructing covers for aeration basins including activity based costing. Report recommendations to FWO and RRES-PP for funding.	SWS/FWO	FY04
Investigate potential of reducing cooling tower releases to SWS including activity based costing. Report recommendations to FWO, RRES-PP, and LANL FM council for adoption and funding.	RRES/FWO	FY03